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THE INTERNATIONAL CONGRESS OF PHYSICAL MEDICINE (1952)

THE first International Congress of Physical Medicine to meet since 1938, and the first to be held under the auspices of the International Federation of Physical Medicine, took place at King's College, London, from July 14 to 19, 1952. There were present 210 full members and 118 associate members, 24 countries in all being represented.

Opening Ceremony

The Congress was officially opened by Marshal of the Royal Air Force Viscount Tedder in the presence of a distinguished Committee of Honour wearing academic robes. Among the members of this committee were the Minister of Health, the Presidents of the Royal Colleges of Physicians and of Surgeons, the President of the Royal Society of Medicine, and the Mayor of Westminster.

Lord TEDDER referred to the outstanding work in the Royal Air Force done by specialists in physical medicine and rehabilitation. He believed that the greatest field of the specialty lay in the restoration of the individual to full physical fitness, for, he said, "life was not merely to be alive, but to be well". As a layman he took a great interest in physical medicine, because in this branch of medicine, in particular, great use was made of self-help and the patient became a partner in his own treatment. [He then lit the ceremonial lamp presented by Lord Horder, which was to burn throughout this and future Congresses, suggesting as he did so that the twin flames symbolized Physique and Physics.]

The Minister of Health, Mr. I. M. MACLEOD, in welcoming the delegates, referred to the application of physical medicine in the rehabilitation of the sick and injured and in the prevention of invalidism among the aged. In calling attention to the need for a new sense of responsibility toward the elderly and chronic sick, he felt that we were in danger of shuffling on to the State, responsibility which ought to be shouldered by the family.

The International Congress of Physical Medicine (1952)

Lord HORDER, on being installed as President of the Congress and invested by Dr. F. H. KRUSEN, President of the International Federation, with the chain and badge of office presented by Mr. Bernard Baruch in memory of his father, emphasized that physical medicine was an integral part of general medicine and must remain so. He felt convinced that in this setting the sky was the limit for the specialty.

Dr. F. H. KRUSEN (U.S.A.) outlined the steps that had been taken in the formation of the International Federation of Physical Medicine, and paid personal tributes to Lord Horder, Mr. Bernard Baruch, and the late Dr. Richard Kovacs. He recommended to members of the Congress the motto of Dr. Simon Baruch, a pioneer in hydrotherapy—"Let unswerving integrity always be your guide." He then handed to the President the gavel and block presented by Mrs. Kovacs in memory of her husband.

Dr. S. CLEMMESSEN (Denmark) thanked the Minister of Health for his speech of welcome, and joined with Professor K. M. WALTHARD (Switzerland) in expressing his appreciation of the British Association of Physical Medicine for arranging the Congress and acting as hosts to the delegates from overseas.

Scientific Programme

During the Congress 52 scientific papers were read and 15 films shown. In addition there were scientific and historical exhibitions and a display of methods of physical education used by the Army and the school medical services. The main contributions are summarized below.

Developments in Physical Medicine in the Past Decade

Dr. F. D. HOWITT (Great Britain) described the part played by physical medicine in the fighting Services and in the Emergency Medical Service during the war. He said that since the war ended there had been a heavy demand for specialists in physical medicine to work in two spheres of activity: first in the hospital service, where they advised their colleagues on the application of physical methods in diagnosis and treatment, and themselves undertook the management of medical disorders of the locomotor system; and secondly in the rehabilitation service, where they worked in close liaison with the social and industrial services.

Dr. F. H. KRUSEN (U.S.A.) described the past decade in physical medicine as memorable. Ten years ago the term "physical medicine" was almost unknown; practice was largely empirical and teaching and research were limited. Since then in the U.S.A. there had come into being a Congress, a Society, and a Council of Physical Medicine. In particular, the Baruch Committee, which was established in 1943, had done a great deal to stimulate interest in the subject. Further evidence of the rapid growth of the specialty was that during the last ten years medical schools offering instruction to students had increased by over 50%, resident posts had increased from 5 to 87, schools of occupational therapy from 4 to 24, and schools of physical therapy from 15 to 31.

Dr. S. CLEMMESSEN (Denmark) described developments in his country and stressed that rheumatology and physical medicine could not be separated. He paid particular tribute to two pioneers, the late Professor J. Lindhard and Dr. J. Helweg.

The International Congress of Physical Medicine (1952)

Dr. V. E. KLARE (Austria) referred to recent research work in physical medicine in that country. In particular, the use of such physical methods as ultrasonics and electrical stimulation of muscles had occupied much of the interest of his colleagues and of himself.

Rehabilitation and Resettlement

Dr. F. S. COOKSEY (Great Britain) summarized the statutory provisions for rehabilitation of disabled persons in Great Britain, with particular reference to the Disabled Persons Employment Act of 1944. He called for greater interest in this subject on the part of medical practitioners, and said that it was for them to initiate the appropriate measures for rehabilitation and resettlement from the beginning of illness. A close integration between family, hospital, and industrial health service had yet to be achieved, and more attention must be paid to the resettlement of the disabled housewife and the chronic sick in their homes.

Dr. T. M. LING (Great Britain) emphasized the importance of the mental attitude developed by disabled and convalescent patients. This must be considered if the patient was to be fully readapted to his family, his surroundings, and his work.

Dr. A. B. C. KNUDSON (U.S.A.) dealt with the physical medicine and rehabilitation service of the Veterans' Administration. He said that in the Administration hospitals 1,400 beds were reserved for rehabilitation cases, and a consultant service was in existence in 154 hospitals.

Dr. G. GINGRAS (Canada) described a rehabilitation pilot centre in Montreal administered by the Rehabilitation Society for Cripples.

Among several papers devoted to the application of physical methods to problems of poliomyelitis was one by Dr. R. L. BENNETT (U.S.A.), who referred particularly to the use of splints and braces in convalescent cases. Dr. V. A. PORSMAN (Denmark) and Dr. L. COSIN (Great Britain) referred to the use of physical medicine and rehabilitation in geriatric departments.

Medical Disorders of the Locomotor System

Discussions on recent developments in the use of endocrines in the management of the chronic rheumatic disorders aroused great interest. The application of these compounds was outlined by Dr. F. DUDLEY HART (Great Britain), who emphasized that they were powerful and therefore potentially dangerous agents to use. He stated that cortisone and ACTH (corticotrophin) must be used only in selected cases under careful supervision and in combination with other methods of therapy.

Dr. F. BACH (Great Britain) felt that cortisone and allied compounds were only rarely substitutes for physiotherapy or surgery; however, used as adjuncts to the older methods they had considerable value.

The combined use of cortisone and physiotherapy in chronic rheumatoid arthritis was further discussed by Dr. E. W. LOWMAN (U.S.A.), who felt that cortisone therapy in rheumatoid arthritis can be accomplished with greater safety if the daily dosage was kept below 75 mg. He said that these drugs cannot be expected to control symptoms arising from superimposed degenerative joint disease; for such changes physiotherapy was the treatment of choice.

Dr. W. A. FELL (Great Britain) discussed the use of procaine injections in the treatment of osteo-arthritis of the hip, and the surgical approach to the problem of rheumatic joint disease was discussed by Mr. H. PETTY (Great Britain). The latter pleaded for the co-operation of orthopaedic surgeons in the early stages of rheumatoid arthritis, emphasizing that in selected cases open surgery is of value during the late acute and early subacute stages of the disease.

The International Congress of Physical Medicine (1952)

Research into the pathology of the rheumatic diseases was the subject of several papers, including a contribution from Drs. W. D. PAUL and J. R. ROUTH (U.S.A.), who described studies they had made on the permeability of synovial membrane.

Dr. R. HARRIS (Great Britain) described studies with radioactive sodium made at the Royal Free Hospital on circulatory changes in the skin and muscle of the hand during reflex heating.

Physical Methods in Diagnosis and Treatment

On the day devoted to this subject there were several papers on modern electro-diagnostic methods.

Dr. J. LEFEBVRE (France) discussed the value of chronaxie in the diagnosis of denervation and the myotonias.

Dr. E. KUGELBERG (Sweden) gave an account of the electromyographic changes that could be found in neuromuscular disorders. He referred to the value of insertion activity in electromyography and of the sharply rising positive potentials which occur in denervated muscle.

Dr. P. BAUWENS (Great Britain) described recent technical advances in electro-diagnosis, and recommended the use of magnetic-tape recording as an aid to the identification of electromyographic phenomena.

Dr. C. B. WYNN-PARRY (Great Britain) analysed the intensity duration curves he had obtained from 78 cases of peripheral nerve injuries and poliomyelitis, and described the changes which occurred in serial intensity duration curves during regeneration and degeneration of peripheral nerves.

[It was noteworthy that the members of the forum discussing electrodiagnosis were in agreement that simple apparatus was adequate for clinical work; in particular, that the use of complicated recording methods for clinical electromyography was not necessary.]

Dr. B. O. SCOTT (Great Britain) gave an account of a recent advance in short-wave therapy based on the use of a cross-fire technique. He illustrated with a colour film the distribution of heat that can be obtained from conventional short-wave and the cross-fire methods respectively.

Care of the Disabled

During the closing session of the Congress Dr. H. RUSK (U.S.A.) stressed the urgent need for facilities to deal with the growing numbers of disabled persons. He said that as a result of increased length of life brought about by improvements in the treatment of acute illness we were faced with growing numbers of patients suffering from chronic degenerative diseases. He emphasized that, although the pathology of many of these diseases was irreversible, this did not mean that the resultant social and psychological effects of such diseases were also irreversible. In an earlier paper he had described methods used in rehabilitation of hemiplegics, and pointed out that 90% of all hemiplegics can be taught ambulation and self-care and that over 30% can be taught to do useful work.

Dr. H. BALME (Great Britain) discussed the results of this increase in physical disability from an international point of view. He described some of the work done by the United Nations Organization.

Reflections on the Congress

It was apparent throughout the week that delegates from all countries were concerned about the marked increase in the incidence of chronic disease and the resultant social and economic problems. It was further

The International Congress of Physical Medicine (1952)

apparent that although much research has been, and is still being, done to find specific treatments for these disabilities, so far their management is mainly by symptomatic treatment and rehabilitation. That so much research is being carried out to improve physical methods of treatment, and to establish their efficacy, is encouraging. The growth of rehabilitation services has been truly amazing, and in particular the importance of establishing the disabled person's independence in the activities of daily life has been universally recognized.

Perhaps the most remarkable feature of the Congress was that it was possible on an international scale for physical medicine specialists to find so much common ground. The scope of physical medicine has greatly altered in recent years, but it is evident that it can now be clearly defined. This scope was perhaps best described in a recent annotation in the *British Medical Journal* as "the diagnosis and treatment of medical disorders of the locomotor system, the application of physical methods in these and other disorders, and the comparatively new fields of prevention of incapacity and medical rehabilitation".

This is our specialty. It has indeed come of age and now ranks with the older branches of medicine.

A. T. RICHARDSON

REHABILITATION OF THE DISABLED HOUSEWIFE

By F. S. COOKSEY

From the Department of Physical Medicine, King's College Hospital, London

HOUSEWIFERY is certainly the largest "industry" in the country, and probably the most important, since a happy and well-run home is a prerequisite for the health and efficiency of school children and industrial workers. Yet, in contrast to the progress made in the vocational training and resettlement of the handicapped child and industrial worker, very little has been done to help the disabled housewife to resume her activities.

Medical rehabilitation to restore physical and mental function so far as possible is available to the housewife, as to other patients, in the hospital departments of physical medicine; but when permanent disability is unavoidable, the disabled housewife is relieved of her responsibilities by the provision of home helps, "meals on wheels", the removal of young children to residential nurseries, and often by another female member of the family giving up her employment in order to help in the home. This somewhat defeatist approach to the problem is anomalous in times when rehabilitation and resettlement in all other fields are directed to training disabled persons to undertake work within their residual physical and mental capacity, so that, with the assistance of any necessary special tools and appliances, they are able to hold their own with the physically capable. The main reasons for this neglect of the housewife are: (1) the preoccupation of the State and family with the disabled wage-earner; (2) the lack of provision in the Disabled Persons (Employment) Act, 1944, for the vocational training and resettlement of the handicapped housewife, since housewifery is not an employment within the meaning of the Act; (3) the absence of a powerful trade union to further the welfare of the housewife; and (4) the lack of an alternative to housework, whereas the disabled wage-earner can be trained for more suitable employment when necessary.

Nevertheless it has been shown in the United States, and more recently in this country, that with suitable training and modification of domestic appliances the majority of disabled housewives can resume their work. This tends to improve the morale not only of the patients themselves but of the whole household; it saves the expense of supplementary aid, and retains in productive work women who would otherwise have to help in the home.

The misery experienced by the disabled housewife sitting inactive at home while paid help or relatives do her work, and the strain on husbands and other wage-earners in the family, are too well known to need description. Clearly as much attention should be paid to this subject as to other aspects of rehabilitation.

Rehabilitation of the Disabled Housewife

The Elderly Housewife

There exists a parallel problem in the increasing number of elderly housewives; this is due to: (1) the rising average age of the population; (2) the fact that women have a relatively longer expectation of life than men; (3) the effect of social changes in making it more difficult to obtain paid domestic help; and (4) the fact that housewives can never retire unless forced to do so by incapacity. These elderly women become physically weaker with advancing years, and many are handicapped by senile degenerative joint changes so that they find it increasingly difficult to kneel, to lift pots and pans, and to reach shelves. Even so they attempt to carry on as long as possible, and this contributes to the high incidence of domestic accidents amongst the elderly. Such modifications to domestic appliances as have been adopted to help the severely disabled would also be of service to the elderly housewife; incidentally, some of the devices would prove an advantage in every home.

The Personal Activities of Daily Living

Before starting to train the disabled housewife to resume her work it is necessary to ensure that she can manage for herself the personal activities of daily living such as dressing, feeding, and hygiene. This important aspect of rehabilitation has received adequate attention in some special centres, such as those for the limbless, the paraplegic, and the blind, but it has not been given the consideration it deserves in its application to the general run of patients. Most doctors, nurses, physiotherapists, and occupational therapists, as well as members of the voluntary services, in particular the British Red Cross Society, have discovered dodges to assist disabled patients in this respect, but no branch of medicine or department in a hospital has made a thorough study of the problem and become the acknowledged centre for research, information, and help.

The obvious centres to undertake this work are the departments of physical medicine. Physiotherapists, gymnasts, and occupational therapists should pay more attention to the personal activities of daily living and relate their remedial treatment to this end as well as to the occupational activities of their patients. Methods should be evolved to enable handicapped patients to look after themselves by:

(1) Studying and practising the normal movements of dressing, feeding, and getting in and out of a bath, and developing trick movements in cases where normal activity cannot be regained. Patients must actually practise these activities, preferably in a group in the gymnasium. Such appliances as a bath fitted with hand rails and a ceiling hoist, and a toilet with a raised seat, should be installed (but need not be plumbed) so that disabled patients can be trained in the best methods of using these essential articles.

F. S. Cooksey

(2) Adapting clothing with such things as zip fasteners or easily managed buttons, and, where necessary, by radical alteration in design.

(3) Using special appliances such as elastic shoe-laces, long-handled shoe-horns, and a device for putting on and taking off stockings. A number of other gadgets are being developed, but are not yet generally available.

Assessment and Vocational Training

At King's College Hospital a room about 14 feet square in the occupational therapy department has been set aside for the assessment and training of the disabled housewife, the ultimate intention being that the room should be fitted up as a combined living-room, kitchen, and bedroom with a bath and toilet adjacent. It has been planned for a woman with paraplegia, confined to a wheel-chair and living alone, as this is probably the most difficult problem encountered in practice; provision is also made for dealing with the less severe forms of disability.

For planning purposes patients have been divided into four main groups: (1) those confined to wheel-chairs; (2) those who can move about the room only by using two sticks or crutches; (3) those with one useless arm, as in the case of amputation or hemiplegia; and (4) those with both arms partially disabled by arthritis or progressive neuromuscular disease.

A study of the functional activities involved in housework reveals a surprisingly large variety of tasks. This is in contrast to most industrial processes, where comparatively few functional movements by the individual worker are required. Because of the complexity of housework it is necessary to decide on some order of priority in the training of the disabled housewife, namely: (1) personal independence in dressing, feeding, and hygiene; (2) the preparation and cooking of meals and washing up after them; (3) washing, drying, ironing, and mending clothes; (4) house-cleaning and the management of fires; and (5) bed-making. Cooking is given high priority because this task occupies most of the housewife's time; no home can be run without regular meals, and the majority of women find it the most interesting and rewarding of all housework. Cleaning can be left to domestic helps until a later stage; coal fires can be replaced by gas or electric fires without undue expense; and members of a family can make their own beds. Bed-making must, however, be given higher priority in the case of a disabled person who lives alone.

The Disabled Housewife's Kitchen

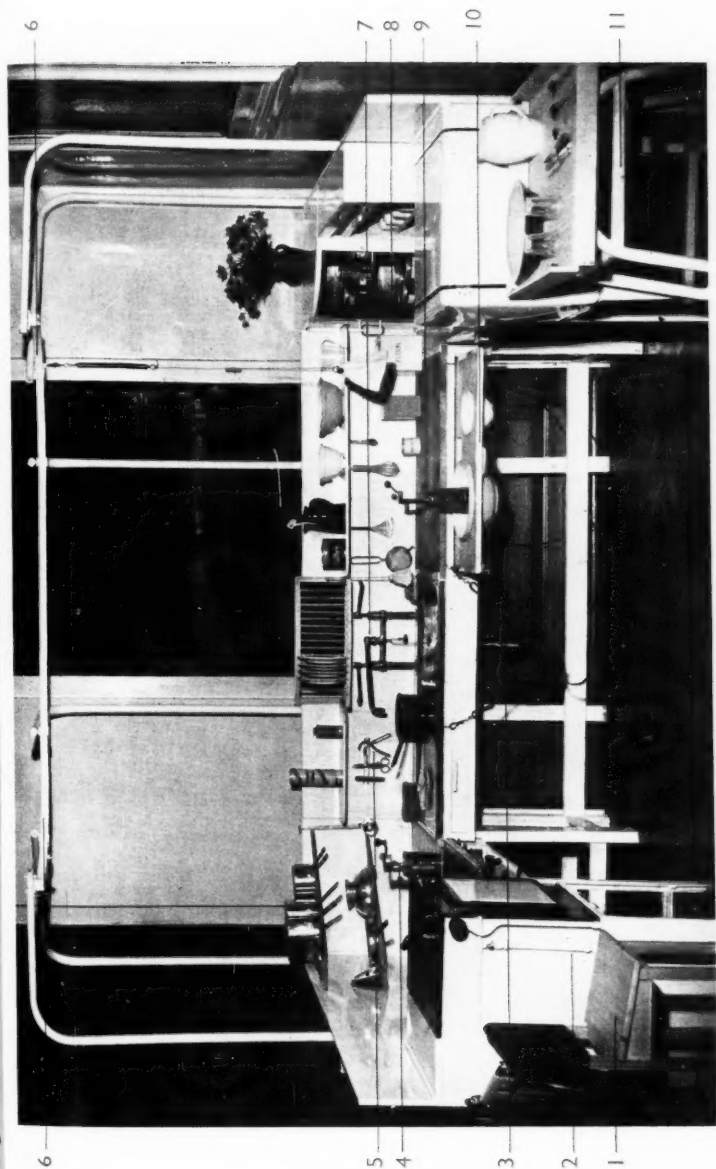
A kitchen unit for the assessment and training of disabled housewives has also been built in the occupational therapy department at King's College Hospital; Plate I shows the general layout. It is impossible in a

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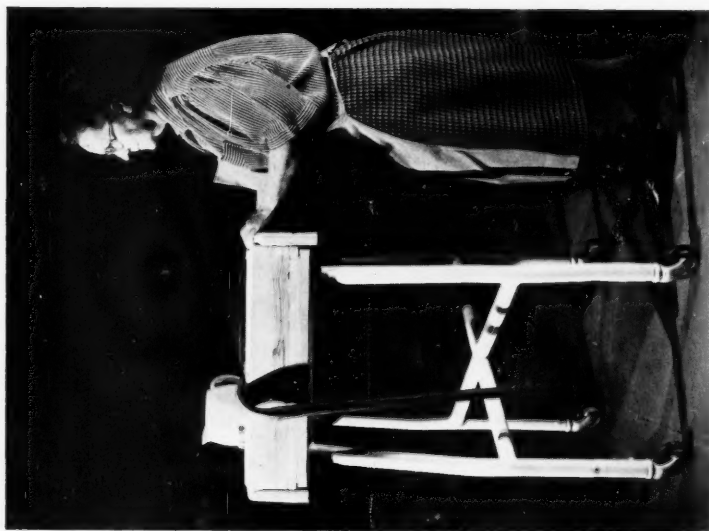
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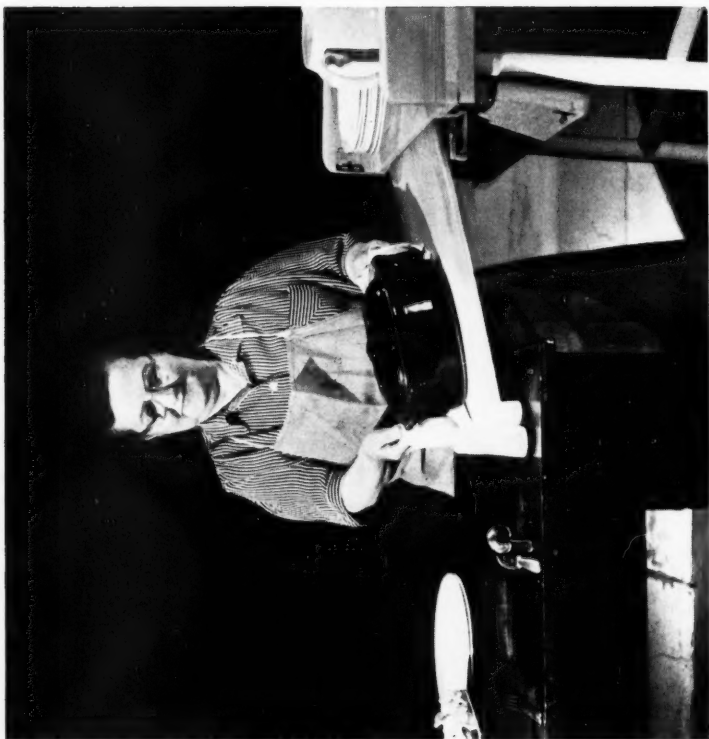
Kitchen unit for training disabled housewives in the occupational therapy department. Dimensions 11 by 6 feet.

1. High chair for arthritis.
2. Pilot light for oven.
3. Safety belt.
4. Tin-opener to operate with one hand.
5. Easy-grip oven tongs.
6. Sling track.
7. Swinging tap with lever handles.
8. Rotating shelves.
9. Universal grip for grater, mincer, potato-peeler, whisk.
10. Pull-out board for holding bowl and tin steady.
11. Walking-trolley (with ramp).

PLATE II.



A, Combined serving trolley and walking chair. Case of left hemiplegia and hemianesthesia.



B, Flap on trolley to facilitate transference of hot and heavy vessels to the dining table.

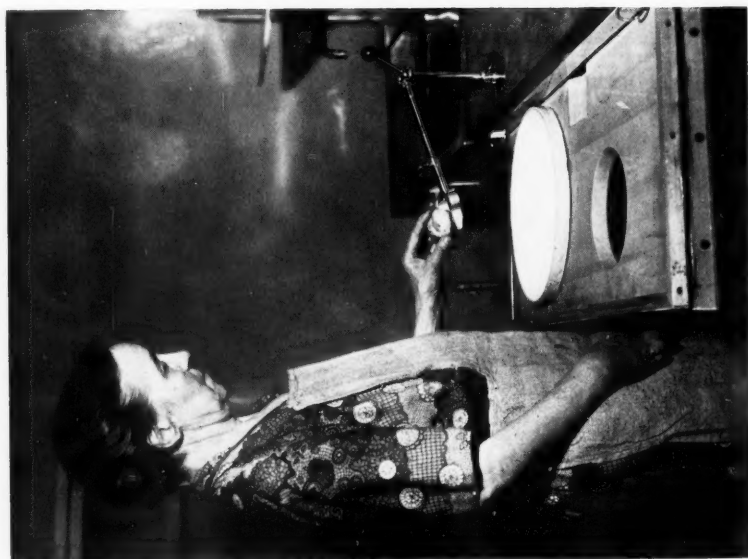
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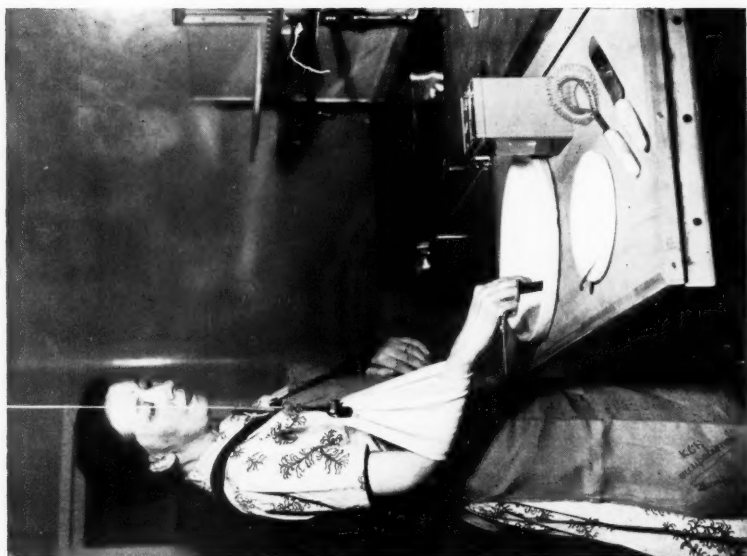
PLATE III.



Kettles and saucepans can be filled and emptied without lifting.



A. Patient with total right hemiplegia using the potato-peeler. Other appliances fit on to the same base plate on the bench and can be fitted and removed by one hand.



B. Drawer to steady mixing bowls and stock tips. Case of poliomyelitis. Patient is unable to use right hand. The slide is attached to the overhead track.

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Rehabilitation of the Disabled Housewife

short article to describe the unit in detail, but reference may be made to some of the salient features.

The unit is planned so that everything is accessible to a patient in a wheel-chair and the minimum of movement is required. Rotating shelves are fitted in otherwise inaccessible corners. The middle shelf of the oven and the hot-plate of the gas cooker, the middle shelf of the refrigerator, and the working surface of the whole unit are on the same level, so that lifting is reduced to a minimum and hot vessels need not be lifted at all. There is a stout trolley the top of which is at the same height as the rest of the unit, in order that patients dependent on crutches can use it like a walking-chair. They can also slide dishes on to the trolley from the oven or the rest of the unit (Plate II). The unit is at a convenient standing height, and to facilitate the transference of dishes to the average dining table, which is some 4 inches lower, a sliding flap is provided on the trolley. Plate II, B, shows a patient with hemiplegia and hemianaesthesia sliding a hot and heavy casserole from the trolley to the dining table. Patients in wheel-chairs also find the trolley useful because it can be loaded and then pushed from the wheel-chair.

Because everything must be within reach from a wheel-chair it is impossible to supply an adequate amount of cupboard accommodation in the unit; therefore a supplementary store cupboard elsewhere in the room is essential. All parts of this must also be accessible from a wheel-chair, and one shelf should be at the same level as the rest of the unit so that the trolley can be used for conveying stores, china, etc., between the cupboard and the unit.

A mixing tap with lever handles and a swinging delivery pipe makes it possible to fill kettles and saucepans without holding them over the sink (Plate III). This is a great boon to patients with a weak grip. For patients with only one useful arm and hand, a pull-out flap is provided in the kitchen unit which holds bowls steady and facilitates the opening of tins and jars. The staff of the physics laboratory has developed a standard clamp to fit various culinary tools, such as potato peelers, graters, mincers, and whisks, so that these appliances can be secured to the working bench and operated by one hand. Plate IV, A, shows a patient with a total right hemiplegia using the potato peeler, and the grater can be seen in position in Plate I.

An overhead track for slings is provided; this allows a patient with a weak arm supported in a sling to move freely from one end of the unit to the other. Plate IV, B, shows a young housewife severely crippled as a result of poliomyelitis. All that survive in the upper limbs are a normal right forearm and hand; but with the aid of the sling and various devices for the one-armed this patient has demonstrated her ability to cook, prepare, and wash up after, a midday meal for other patients.

Stools are made with the seat at the correct height and slope to suit

F. S. Cooksey

individual arthritic patients who are unable, without help, to sit on or rise from a chair of normal height. The stool enables such a patient to take most of the weight off her joints when working, and the trolley permits her to move about safely; a useful additional device is a safety belt to be worn by the patient and clipped on to the unit when working. These three appliances can be identified in Plate I.

Practical Application in the Patient's Home

Disabled housewives prepare, cook, and wash up after a midday meal for a dozen or more patients attending the occupational therapy department for a rehabilitation programme occupying a whole day. After assessing the requirements of a disabled housewife, the occupational therapist visits her home and, in consultation with the patient and her husband, decides what adaptations are necessary. The things most often required are: a board between the cooker and sink in order that pots and pans may be slid and not lifted, a board to steady bowls, a set of appliances with a universal clamp if the patient is hemiplegic, and a walking trolley and stool if she is arthritic. Most of these are made by patients in the workshop and supplied at the cost of the raw materials used. Occasionally it is necessary to fit hooks in the ceiling to support slings, or to replace a coal fire by a gas or electric one. In such cases the almoner contacts the patient's landlord or the local authority for the necessary permission, and when the patient cannot meet the cost herself, tries to raise the money to pay for it. Similarly, when necessary, arrangements are made to fit hand rails in lavatories and bathrooms, also to instal ramps and widen doorways to facilitate movement in wheel-chairs.

When deciding how much should be spent in adapting the home and supplying special appliances it is necessary to take into account the nature of the disability. Obviously for young housewives with a permanent lesion such as that due to poliomyelitis any reasonable expense is justified if it will enable her to look after her family and lead a life as nearly normal as possible. In the case of the older housewife with a progressive degenerative disorder the expenditure must bear some relation to the prognosis.

Conclusions

The management of the personal activities of daily living and the vocational training and resettlement of the disabled housewife are medico-social problems of considerable magnitude which have not received adequate attention in the past. There is in this field a great opportunity for physical medicine to collaborate with the welfare departments of the local authorities and the voluntary associations in establishing the same complete rehabilitation service for the disabled housewife as is available for the handicapped child and industrial worker.

Rehabilitation of the Disabled Housewife

Summary

1. Housewifery is one of the most important "industries", though it is not recognized as such either by the public or by Acts of Parliament.

2. Facilities for rehabilitation of the disabled housewife are poor, and compare unfavourably with those available for the industrial worker and the handicapped child.

3. In the treatment of the severely disabled housewife the patient must first be taught to carry out the personal activities of daily living (feeding, dressing, and personal hygiene). Where necessary, clothing may be adapted (zip fasteners, special buttons) and certain gadgets supplied (elastic shoe-laces, long-handled shoe-horns).

4. Later, the patient is re-educated in normal household duties (cooking, washing and ironing clothes, house-cleaning, bed-making). For this purpose a domestic section in the rehabilitation department is useful.

5. When the patient has returned home, simple adaptations can be made in the kitchen and other rooms so that household tasks can be performed unaided.

Acknowledgments

I wish to thank Miss MacCaul and her staff in the Occupational Therapy Department for their constant help and enthusiasm, the Physics and Engineering Departments for help in the design and construction of various appliances, and the Board of Governors of King's College Hospital for providing the necessary facilities.

VARIATIONS IN STRENGTH DURATION CURVES AND EXCITABILITY INDICES IN NORMAL SUBJECTS

By R. HARRIS

From the Department of Physical Medicine, Royal Free Hospital, London

THE plotting of strength duration (I/T) curves is rapidly replacing the classical faradic-galvanic test of muscle-nerve excitability. The general interpretation of these curves is widely appreciated, particularly in the investigation of peripheral nerve lesions; the distinction between normal and denervated muscle curves presents few difficulties. The importance of serial investigations, and of using these tests in conjunction with other methods—e.g. nerve-trunk stimulation and electromyography—has been emphasized by Ritchie (1945) and by Bauwens and Richardson (1951).

The electronic apparatuses now available are robust and reliable; they are a real advance on previous types. However, unless standardized techniques are adopted, comparable and consistent results cannot be obtained. This is particularly important in the investigation of certain locomotor diseases, in which smaller variations of nerve-muscle excitability than are found in peripheral nerve lesions may be significant—e.g. anterior poliomyelitis (Mackenzie, 1949), rheumatoid arthritis (Harris, 1950), metabolic disorders (Chieffi, 1949), and senile muscular dystrophy (Boulière, 1948).

Ritchie (1948) pointed out that strength duration curves, now extensively used, automatically include measurements of rheobase (R) and of chronaxie (C). Variations of these physiological constants within physiological limits have received little attention, and virtually no figures of such normal variations are available. Figures formerly considered standard are no longer comparable to those obtained by present-day techniques.

As an essential preliminary to the study of muscle excitability in certain pathological conditions, the electrical excitability of muscle in a group of normal subjects was investigated both under standard conditions and during alterations in environment.

Method and Apparatus

The Ritchie-B.N.I. (Grey Walter and Ritchie, 1945) constant-voltage square-wave electronic stimulator with a voltage range of 0–115 volts and variable pulse durations of 0.02, 0.05, 0.1, 0.5, 1.0, 10, and 100 milliseconds was used. The variable pulse repetition rate was set at 1.5

Strength Duration Curves and Excitability Indices

per second. The machine was calibrated monthly and used at a time of day when mains fluctuation was minimal. Stimulation was by a simple 1-cm. diameter disk electrode. The muscles used at each investigation were the first dorsal interosseous and the abductor minimi digiti of each hand—four muscles in all. The subjects were tested after 30 minutes' rest in the same room, skin temperature being within the range of 30°–33° C. The motor point was marked permanently on the skin. (For details, see Harris, 1950.) The apparatus and technique employed compare favourably with those generally used in clinical practice.

Possible Variations

In peripheral nerve injuries, alterations in the strength duration curves which may be significant are found in—(1) shape of curve (e.g. discontinuities), (2) threshold (total curve height and rheobase), and (3) slope of curve as shown by the chronaxie (Bourguignon, 1923) or Lasalle's (1928) index (R^2C).

Results in Normal Subjects

Thirty subjects were studied, ten of them serially. These latter had curves plotted at two- or four-weekly intervals for four readings. A total of 120 readings of the first dorsal interosseous (right and left) and the abductor minimi digiti (right and left) were obtained.

Shape of Curves

All curves showed the features characteristic of normal strength duration curves (Katz, 1939). None showed discontinuities or kinks.

Rheobase (R)

Threshold values depend upon both skin resistance and tissue excitability. Despite an exacting technique to ensure constant skin temperature, considerable variations in rheobase were found. For the same muscle in the same patient the serial variation was usually under 10 volts (20%). However, in one subject a difference of 26 volts was found between maximum and minimum rheobases. The rheobase of the abductor minimi digiti was usually about 5 volts lower than that of the corresponding first dorsal interosseous.

In general, when the rheobase of one muscle was raised, that of the other tested muscle of the same hand was similarly raised. The rheobase varied considerably between the same muscles of the two hands; usually there was 2 to 7 volts difference. The greatest difference found between two similar muscles at the same time was 22 volts. (See Fig. 1.)

Slope of Curve (Excitability Indices)

Chronaxie (Harris, 1951) is widely recognized as an index of excitability. Lasalle's (1928) index and Lewy's (1935) index (\sqrt{RC}) appear

R. Harris

to have no real advantages over the chronaxie, and these three indices vary together. The last two indices are little used in this country, but their values have been calculated and are included in the table of findings.

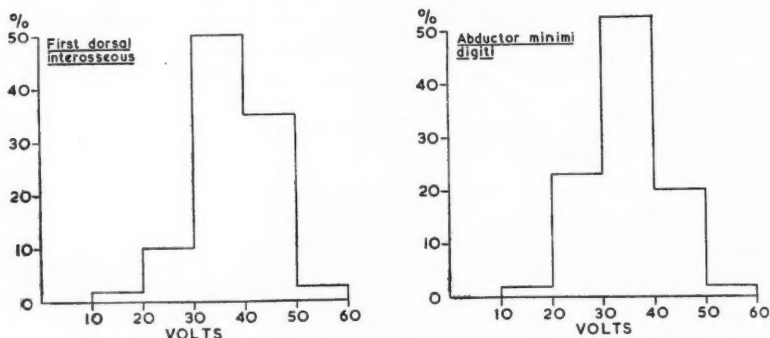


FIG. 1.
Distribution of rheobase values in normal subjects.

Chronaxie

This was fairly constant in the same muscle followed serially, and lay within quite narrow limits. The maximum variation was found to be as much as 50% in one subject, though the variation generally was about 10%. The distribution of chronaxie values is shown in the accompanying graphs (Fig. 2).

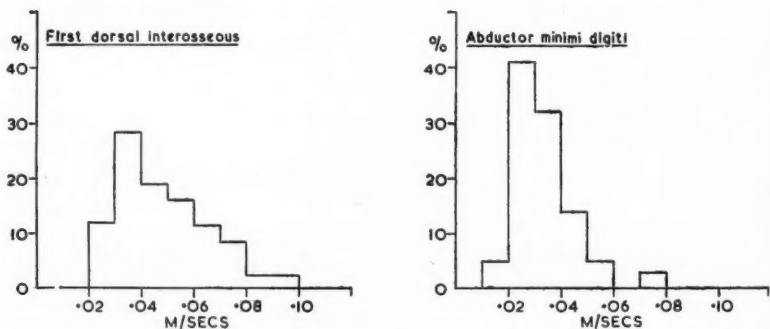


FIG. 2.
Distribution of chronaxie values in normal subjects.

Correlation of Chronaxie and Rheobase

It has been suggested that a high chronaxie is usually associated with a low rheobase. These two factors, when plotted against each other, showed a random scatter with no definite relationship.

Strength Duration Curves and Excitability Indices

SUMMARY OF FINDINGS

	First Dorsal Interosseous				Abductor Minimi Digniti			
	Chronaxie (millisec.)	Rheo- base (volts)	Lasalle	Lewy	Chronaxie (millisec.)	Rheo- base (volts)	Lasalle	Lewy
Mean value	0.049	38.2	83.0	1.50	0.037	33.5	57.2	1.25
Standard deviation . .	0.018	7.6	30.5	0.22	0.012	7.7	16.0	0.165
Coefficient of varia- tion	36.6%	20%	36.7%	15%	32.4%	22.2%	28%	13%
Range	0.02-0.1	20-58	32-155	1-1.9	0.017-0.08	20-53	10-128	0.7-1.8
Maximum individual variation	38%	66%	100%	42%	50%	60%	155%	57%

Results in Arthritic Subjects

Two groups of patients with arthritis were similarly studied. (a) In 10 patients with osteo-arthritis of hip or knee single investigations of the four test muscles were made, giving a total of 20 readings of the first dorsal interosseous (right and left) and of the abductor minimi digiti. (b) 5 subjects with tuberculosis of hip or spine were serially examined, readings being taken at monthly intervals for four to five months. Only one hand was used in 3 of the subjects. In all, then, 34 readings were made of the first dorsal interosseous and of the abductor minimi digiti. The two groups *a* and *b* added together gave an additional 54 readings for each muscle. The findings compared very closely with those found in the "normal" series and lay within the same limits.

When these readings are added to those obtained in normal subjects the total number of curves studied becomes 174 for the first dorsal interosseous and 174 for the abductor minimi digiti. Of the total 45 subjects studied, 15 had been followed serially. From the results it can be seen that, even with careful technique and under standardized conditions, considerable variations in muscle excitability, as measured by threshold levels, rheobase, and chronaxie, can be expected.

Variations Produced by Environmental Factors

Alterations in environment which are known to influence muscle excitability and strength duration curves are: (1) temperature; (2) blood supply; (3) exercise; (4) oedema; and (5) position of the electrode.

1. Temperature

Skin blood flow varies with the skin temperature, and thus affects skin resistance and threshold values. Complete displacements of the strength duration curves can be brought about by alterations in temperature. In general, the threshold falls with rise in skin temperature, and vice versa. Strength duration curves were plotted in 4 normal subjects at skin temperatures between 25° and 35° C., four readings for each subject being taken of the first dorsal interosseous and the abductor minimi digiti. Minimal changes in threshold accompanied temperature

R. Harris

changes of 2° to 3° C. Further increases in temperature consistently lowered the thresholds, and an alteration of rheobase of 10 volts occurred as a result of a temperature change of 7.2° C. (Fig. 3). However, chronaxie values remained relatively unchanged and curve forms were completely normal.

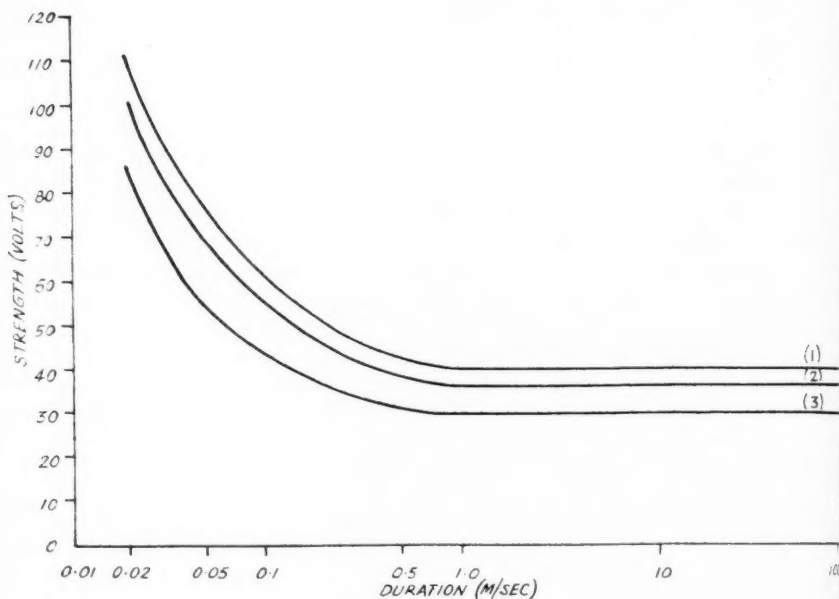


FIG. 3.

Effect of temperature on first dorsal interosseus. (1) 27° C. (chronaxie 0.043 m/s.). (2) 31° C. (chronaxie 0.043 m/s.). (3) 34.2° C. (chronaxie 0.038 m/s.).

2. Blood Supply

Ischaemia decreases muscle excitability and raises threshold levels; with gross ischaemia the curves obtained approach those found in denervation. Two groups of experiments were performed:

(a) *Arterial Obstruction*.—A tourniquet at a pressure of 200 mm. Hg was applied to the arm for 15 minutes. Curves were plotted before the tourniquet was applied, at five-minute intervals while it was *in situ*, and after its removal. Readings were therefore taken of normal muscle, and of muscle at different stages of ischaemia and during reactive hyperaemia.

Four normal subjects were studied, two of them twice. The curves showed an upward displacement during ischaemia, maximally during

Strength Duration Curves and Excitability Indices

application of short-duration stimuli. Occasionally the whole curve fell below normal level after removal of the tourniquet, but then returned to normal. No discontinuities were seen. Chronaxies rose during the ischaemic stage by more than 100% and then returned rapidly to normal. (Fig. 4.)

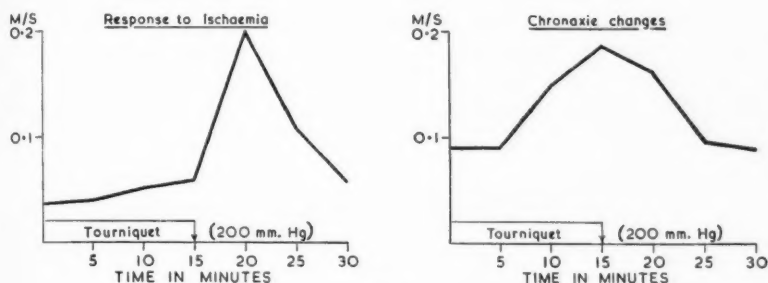


FIG. 4.
Response to the application of a tourniquet.

(b) *Venous Obstruction*.—A tourniquet was applied to 4 subjects for 15 minutes at a pressure between diastolic and systolic, and strength duration curves plotted. The curves were displaced upwards by 5 to 7 volts, equally affecting the whole of the curves. No real alterations in chronaxie were found; increases of the order found in arterial obstruction were never observed.

3. Exercise

Curves were plotted before and after 10 minutes of exercise (gripping a soft rubber ball), and then after a further 10 minutes, in 4 subjects. Two showed no alterations, and in the other two there were decreases in rheobase (2 to 4 volts). Chronaxies were unaffected.

4. Oedema

Three subjects with gross oedema of the hand were investigated. All showed a high threshold (rheobase 56, 68, and 75 volts respectively). In only one could enough points be plotted to give a chronaxie reading (0.14 millise.).

Mackenzie (1948), by injecting saline around the motor point, obtained upward displacements of the whole curve, the displacement depending upon the amount of saline injected; he does not, however, state the chronaxie values thus obtained.

Oedema apparently increases tissue resistance, and this is shown by an increased threshold to stimuli of all durations, giving rise to total upward displacements of otherwise relatively normal curves.

R. Harris

5. *Position of the Electrode*

Ritchie (1948) considered that "accurate identification of the motor point is important in the case of normal muscle; deviation therefrom does not alter the shape of the curve, but it raises the intensities needed for stimulation". This was confirmed within limits, the abductor minimi digiti of 4 subjects being used. The motor point was marked on the skin and curves plotted at points 1, 2, and 3 cm. respectively from it. The threshold of all curves rose with distance. Within 2 cm. of the motor point, changes in the height, rheobase, and chronaxie were small; beyond this range they increased considerably, and at 3 cm. the rheobase had increased by 4 to 6 volts and the chronaxie up to 400%.

Standard of Response

A *just palpable* contraction was taken as the standard response throughout this investigation. This was compared with a *just visible* contraction (8 subjects). If suitable cross-lighting can be arranged, both are equally satisfactory, though the operator's position must be changed when different muscles are studied if the "visible response" is to be kept standardized.

Discussion

It can be seen that many factors may influence the strength duration curves of normal muscles. Where gross variations from the normal occur, as in peripheral nerve injuries, such physiological deviations will not obscure the findings, as may well happen in other conditions. Indeed, findings within the range of normal have been described as of pathological significance (Harris, 1951).

Bauwens' technique (Bauwens and Richardson, 1951), in which a variable shunt is used to adjust the meter readings to a base-line figure, gives threshold values as multiples of the rheobase. This simple manoeuvre largely eliminates the tendency to place undue reliance on rheobase variations and could well be generally adopted. The apparatuses commercially available lack this refinement.

It has been shown that the alterations produced by environmental factors are largely in rheobase values and produce total displacements of the curves; discontinuities never occur. Chronaxie changes are found only with the most gross variations in environmental conditions, and otherwise are little greater than variations found under controlled conditions in interval measurements on normal subjects.

In the application of this technique to the study of the pathological neuromuscular system the range of values found in normal subjects must be appreciated and taken into consideration. It must be emphasized

Strength Duration Curves and Excitability Indices

that the values given in this study apply only to the two particular muscles used, and to the particular technique and apparatus.

Summary

(1) The range of values and variation in the excitability indices of muscle obtained from strength duration curves in normal subjects were studied under normal conditions and also during changes of environment.

(2) Even with the most exacting techniques there is a wide range of normal values; serial investigations may show individual variations of over 60%.

(3) Variations of excitability occur (a) with increased temperatures; (b) with ischaemia; (c) with oedema; and (d) with different positions of the electrodes. Slight changes only occurred with venous obstruction and with exercise.

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DISCUSSION ON MANIPULATION

AT THE ANNUAL MEETING OF THE BRITISH ASSOCIATION OF PHYSICAL
MEDICINE ON APRIL 25, 1952

I—E. J. CRISP

THOSE of us who manipulate backs must have observed that certain types of "disk lesion" appear to be much more amenable to this form of treatment than others; that whereas some patients can be relieved by a single manipulation, others respond less dramatically and require a more prolonged period of treatment; while a number may show no response at all, immobilization in plaster remaining the more rational and successful procedure.

I am sure it is not merely a question of good or bad technique; there is more to it than that. Were Professor Joad faced with the problem he would most likely remark, "It all depends on what you mean by a disk lesion." This, I think, is the crux of the matter, and while remaining convinced that backache is usually skeletal in origin, I no longer believe a disk lesion to be the invariable cause. Correction of an intervertebral derangement not involving the disk is the obvious explanation of the rapid relief which so often follows manipulation.

Study of a lumbar intervertebral joint should enable us to appreciate the various lesions and derangements to which it may be subject, and to understand why manipulation is so much more successful on some occasions than others. It should also, in part, supply the answers to three important questions: "What to manipulate", "When to manipulate", and "How to manipulate". Without this knowledge, which is fundamental, we cannot hope to achieve success.

The Intervertebral Joint

The intervertebral joint is a complex structure. The joint between the vertebral bodies is placed anteriorly, and together with the disk forms a synchondrosis, but by no means an ordinary synchondrosis, for the disk is a hollow fibro-cartilaginous structure distended by a gelatinous nucleus under considerable pressure. Posteriorly we find the articular facets, each one forming with its immediate neighbour a normal diarthrodial joint, complete with capsule and synovial membrane. In addition there are the anterior and posterior longitudinal ligaments and the ligamenta flava.

The tendency for a disk to degenerate comparatively early in life, its vulnerability to injury, and the varying types of lesion to which it is subject are appreciated by all. Unfortunately attention has now become focused

Discussion on Manipulation

on the disk to the almost complete exclusion of other components of the intervertebral joint, and low back pain of sudden onset tends to be automatically labelled "disk lesion".

The apophysial joints can most certainly give rise to pain, and in more ways than one. Kraft and Levinthal (1951) have recently drawn attention to a condition which they term "facet synovial impingement". They point out the innumerable variations in the shape and position of the facets, and how the plane of the apophysial joints may vary from the sagittal to the coronal. Stability is greatest with the joints in the sagittal plane, lateral movement being somewhat restricted. Greater movement is possible in all directions when the joints lie in the coronal plane, and accordingly there may be considerable laxity of the capsule and redundancy of the synovial membrane. Thus flexion or flexion-rotation of the lumbar spine may open up a joint space sufficiently for the synovial membrane to prolapse between the facets and become pinched when extension is attempted. This would subject the synovial membrane to considerable trauma and give rise to acute pain. The synovial membrane may remain nipped between the facets and, becoming oedematous, form a mechanical obstruction to extension, the lumbar curve remaining reversed. This chain of events, though conjectural, provides a perfectly rational explanation for a type of acute low back pain that responds excellently to manipulative therapy, the manipulation presumably freeing a nipped synovial fringe rather than reducing a disk protrusion. Recurrent nipping of the synovial membrane might well give rise to chronic thickening of the capsule and synovial membrane.

When an intervertebral disk becomes narrowed, the overlap of the articular facets must obviously be increased. This will interfere with the normal mechanics of the apophysial joint and frequently lead to osteoarthritis with concomitant capsular and synovial changes, which give rise to pain. As in the case of pain arising elsewhere in the body, this pain can be relieved by stretching the capsule and ligaments of the joint.

Although it cannot be demonstrated radiologically, it is probable that if the disk is narrowed and the intervertebral ligaments are lax, minimal subluxation can occur in an apophysial joint, causing "locking" and acute pain.

The intervertebral ligaments themselves often give rise to pain, especially after the occurrence of a disk lesion. When posterior annular rupture occurs the posterior longitudinal ligament also sustains trauma, and following subsequent annular repair may become involved in the scar tissue. Likewise a nerve root may become adherent through the formation of adhesions. All these conditions are amenable to manipulation.

Several observers (Dockerty and Love, 1940) have noted that the ligamentum flavum often sustains trauma simultaneously with the disk,

E. J. Crisp

resulting in subsequent fibrosis and thickening. The condition may be recognized by the exaggerated and fixed lumbar lordosis, which is permanent and not accompanied by muscle spasm. In contrast to conditions previously mentioned, it does not respond to manipulative therapy.

While focusing more attention on the apophysial joints and the ligaments we must not lose sight of the disk, which remains the most vulnerable component of the intervertebral joint and is repeatedly the cause of low back pain and sciatica. The sacro-iliac joints and the coccyx, in my opinion, are seldom responsible for symptoms, pain being referred to them rather than arising in them.

Diagnosis

Though it is often extremely difficult to decide which intervertebral component is responsible for the patient's symptoms, there are fortunately a number of objective signs which, considered together with the history, simplify the differential diagnosis.

Low back pain and stiffness in association with sciatica and hamstring spasm would be strongly suggestive of a disk lesion. The presence of paraesthesiae, neurological signs, or a positive "well-leg" test would clinch the diagnosis. On the other hand, the combination of low back and sciatic pain without hamstring spasm or neurological signs might well indicate that the lesion was ligamentous or apophysial rather than due to a disk, and the pain of the referred type.

Observation of the shape of the lumbar spine enables certain deductions to be drawn. When muscle spasm restricts forward flexion so that the lumbar spine is "tight", and there is acute low back pain radiating to one or other buttock, the clinical picture points to an annular lesion, especially if there is also spasm of the hamstrings, and at the same time rules out the likelihood of a nipped synovial fringe.

Cases of acute low back pain of sudden onset and characterized by a reversed lumbar curve are fairly common. This type of deformity might equally well be due to a large posterior disk protrusion or a nipped synovial fringe, but I think we can distinguish between the two. If there is no sciatic pain it is improbable that there is a posterior disk protrusion, for with the lumbar spine in the flexed position such a protrusion could hardly avoid impinging on one or more nerve roots. In this case, therefore, a nipped synovial fringe is the more likely diagnosis. Conversely, a reversed lumbar curve in association with sciatic pain and hamstring spasm is strongly indicative of a disk protrusion.

The mode of onset in the case with the reversed lumbar curve is also instructive, for if it coincided with a cough or sneeze while the patient was in the upright position it obviously could not be due to a nipped

Discussion on Manipulation

synovial fringe. Finally, though both conditions—disk lesion and nipped synovial fringe—respond to traction, the latter condition responds so dramatically as to make it inconceivable that a disk could have been responsible for the symptoms.

In addition to excluding such conditions as Pott's disease or neoplasm, radiographs may provide much useful information. Evidence of congenital abnormalities in the lumbosacral region or variation in the planes of the articular facets often enables a more accurate diagnosis to be made. Again, findings such as normal disk spaces and the absence of marginal lipping in a patient who has suffered recurrent lumbago over a number of years, at least suggests that the disks are not at fault.

In a proportion of cases it will be impossible to pinpoint the intervertebral component responsible for the symptoms, and it would therefore appear desirable to substitute the term "deranged intervertebral joint" for "prolapsed intervertebral disk", as this diagnosis would cover all eventualities.

How to Manipulate

We now have to answer the questions what, when, and how to manipulate. So much harm can be done by a faulty, ill-judged manipulation that the question of technique should be considered first. By this I mean the basic principles of manipulation rather than individual technique, which each operator should work out for himself. Study of the anatomy of the disks and the mechanics of the intervertebral joint supplies the necessary information. The nucleus is contained within the annulus under considerable pressure, and the annulus is much thinner posteriorly than anteriorly. Forced flexion of the lumbar spine is therefore absolutely contraindicated. The axis for rotation is situated posterior to the thecal canal at the junction of the laminae and the spinous process; therefore rotation must subject the disks to considerable distortion. For this reason forced rotation is permissible only in the absence of an acute disk lesion and provided the operator bears in mind the inherent risks and does not employ undue force. The only really safe manipulations, therefore, are: extension, with or without counter-pressure on the affected segment; lateral flexion; distraction; and such measures as "springing the lumbers".

Manipulation of the lumbar spine is best carried out without anaesthesia, the manipulation being repeated at intervals if and as required. Another essential is complete relaxation, preliminary infra-red irradiation being desirable. Forced movement should never be carried out in a jerky manner. The spine should be moved as far as it will go in the desired direction, the operator giving a firm thrust when all the slack has been taken up.

Traction is a most rational method of treatment and, while usually

E. J. Crisp

producing some relief, has the great virtue that it cannot do harm. In my experience it is often the only form of manipulation necessary. It can be performed with the patient prone and two people pulling, or preferably on a suitable apparatus, when the traction may be sustained. By traction the bodies of the vertebrae can be separated so that a protrusion may reduce, the articular facets separated (thereby allowing a nipped synovial fringe to be released), sensitive ligaments stretched, and adhesions freed.

According to the individual patient and the type of lesion, the tension applied to the lumbar spine may vary from 60 to 120 lb. and its duration be as long as 15 minutes. There is usually a definite poundage at which the pain disappears, and this is generally sufficient. At the end of treatment tension should be reduced gradually. Patients with acute low back pain, but without sciatica, and the more chronic types usually attend as out-patients for this treatment, but the patient with a more serious lesion complicated by severe sciatica is best treated as an in-patient and, when relieved, immobilized in a plaster jacket.

Though acute low back pain can often be relieved by a combination of forced extension, lateral flexion, and rotation, traction alone gives such excellent results and is so much safer that I tend more and more to reserve the other manœuvres for the chronic type of case.

In a recent series of 50 cases which was very carefully observed and in which traction alone was employed, 17 cases of acute low back pain a number with reversal of the normal lumbar curve, were all completely relieved by several treatments on the traction table. They were obviously not all cases of disk lesions. Of 12 patients with acute low back and acute sciatic pain whose symptoms were undoubtedly due to a disk lesion, 9 were completely relieved and 2 improved, while only 1 showed no improvement, the average period of treatment being three weeks. It is noteworthy that at least 3 of these cases had failed to respond to prolonged bed rest or immobilization in plaster elsewhere, while in 4 others the condition had been aggravated by manipulation under anaesthesia. Of 5 patients with residual low back pain and chronic sciatic pain subjected to traction, 4 were relieved, while the fifth was improved.

A number of cases of chronic low back pain without sciatica were treated. Many of these were in women in the 45 to 55 age group, so it is not surprising that the results of treatment were less satisfactory. Though most admitted to some improvement, only about 50% obtained complete relief. It became apparent that a painful low back condition in which lumbar flexion was greatly restricted, and which had been present for a number of years, did not show much response to either traction alone or a more general manipulation, and for this type of case the corset remains the treatment of choice.

Discussion on Manipulation

Six patients with persistent or recurrent sciatic pain after laminectomy were subjected to traction, 2 obtaining very considerable relief.

Though this is admittedly a very small series, it does at least emphasize the value of sustained traction as an individual treatment which is capable of producing almost 100% rapid relief in acute lumbago; which relieves 75% of cases with acute sciatica, though the period of treatment is considerably longer, 75% of cases with residual pain persisting after a disk has clinically healed, and 50% of cases with chronic low back pain.

When to Manipulate

The question of "timing" the manipulation is related to the technique to be employed. If traction is not available, it will as a rule be advisable to treat the acute disk lesion with bed rest or a plaster jacket. On occasion the pain may be so intense, or the patient so apprehensive, that for the time being even traction is out of the question. Complete bed rest with the administration of opiates is then indicated, manipulative treatment being resorted to only when the patient's condition permits. Likewise, if the acute symptoms are already abating rapidly when the patient is seen for the first time, an expectant attitude should be adopted and nature allowed to take its course. If manipulative treatment aggravates the condition, it should be discontinued, though it may be justifiably resumed at a later date. The following case illustrates this point well.

A young man developed acute low back pain, and later sciatica, following strain at work. Treatment elsewhere, consisting of prolonged bed rest and manipulation under an anaesthetic, did nothing to relieve his symptoms. On examination the lumbar spine was seen to be flat, movement was considerably restricted, and there was gross spasm of the hamstrings. Treatment on the traction table gave only temporary relief, the pain always returning several hours later. A plaster jacket was accordingly applied immediately after traction treatment and the patient sent home to rest in bed. Six weeks' rest at home in the plaster jacket having failed to produce any relief, it was decided to try the effect of traction with the patient in plaster. After several treatments on these lines he started to lose his pain and to stand upright for the first time. The plaster was then removed, as it became evident that the protrusion had at last reduced, and a second plaster was applied with the lumbar spine in full lordosis. The patient is now almost symptom-free. Like other patients recovered from an acute disk lesion, he will in due course be supplied with a lumbar brace, which will be worn as long as it is needed.

What to Manipulate

All types of low back intervertebral derangement, whether acute or chronic, are amenable to manipulative treatment provided a suitable technique is employed.

The acute disk lesion, with or without sciatic pain, and the acutely nipped apophysial synovial fringe should be treated by traction alone and usually does well. The more chronic types, in which pain may arise in

E. J. Crisp

sensitive intervertebral ligaments or be due to an adherent nerve root, apophysial capsulitis, or other similar condition, all do well with traction alone. In these cases, however, it is justifiable to use other manipulations, such as forced extension, lateral flexion, and rotation, and there will be occasions when these additional manipulations are necessary to procure complete relief.

Summary

1. Most varieties of acute low back pain, with or without sciatica, recover spontaneously if the patient is rested completely or immobilized in plaster for a sufficient length of time. Though this method remains the treatment of choice for certain types of acute disk lesion, manipulation offers a short-cut to recovery in the majority of cases.

2. It is probable that too much attention has been focused on the intervertebral disk as the cause of acute or chronic low back pain. It is suggested that on many occasions the pain arises in the apophysial joints, and that when this is so response to manipulation is usually rapid and often dramatic.

3. The term "deranged intervertebral joint" is suggested as an alternative to "prolapsed intervertebral disk".

4. Of the various manipulative measures which may be employed in the treatment of low back pain, traction is the most rational, most effective, and least dangerous.

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II—G. D. KERSLEY

It is a controversial question who should decide when a patient with arthritis should be treated by manipulation and who should carry it out. When a physician interested in arthritis works in close contact with the orthopaedist I feel that the former should instigate the treatment. He knows the whole background of the case, the alternative methods of medical and physical treatment, and the home and industrial conditions. He can follow up the patient and compare the results of manipulation with those of other treatments. The orthopaedic surgeon, on the other hand, sees only a selected group of cases and may thus be biased. Having decided that manipulation may be beneficial, the physician should discuss the situation with his orthopaedic and physical medicine colleagues. As to whom should perform the manipulation, I think this is a matter of choice, provided that the manipulator is master of his art and fully conversant with rheumatic problems. The operator who does an occasional manipulation is a menace. Every case must be considered on

Discussion on Manipulation

its merits: the disease and its activity, the changes in and around the joint, the particular joint concerned, and the temperament and general condition of the patient, all require assessment.

Dangers

In theory it is a platitude that the diagnosis must be made before any joint is manipulated; in practice there is a temptation to try a manipulation for a pain that is not reacting satisfactorily to other treatment. In consequence such obvious pitfalls as tuberculosis and neoplasm are sometimes overlooked. The mildest trauma may cause a flare-up of gout, and excessive osteoporosis in rheumatoid arthritis may lead to a spontaneous osteotomy, even in the hands of an expert manipulator. A less well recognized danger is the risk of spontaneous subluxation in the cervical spine when manipulation of the neck is performed on a patient with tonsillar or pharyngeal sepsis. The pathology in this instance is uncertain, but it is thought that as a result of nasopharyngeal infection, hyperaemic softening of the ligaments, sometimes accompanied by some degree of osteoporosis, occurs.

Indications

Two groups of patients respond particularly well to manipulation: those with an antecedent history of trauma including surgical trauma, and those who on examination show painful limitation of joint movement in one direction only.

Regional Factors

Certain joints or groups of joints respond to manipulation better than others. The painful neck with limitation of movement and no, or only slight, X-ray changes of osteo-arthritis often responds well. Painful backs have already been discussed (pp. 134, *et seq.*), though it may be noted that cases of sciatica whose aetiology is obscure even after careful examination may benefit. With shoulders it is important to remember that the head of the humerus is often drawn up under the acromion, and unless this contracture is overcome manipulation will only traumatize the soft tissue. Wrists and fingers are sometimes improved by lateral and antero-posterior movement. Osteo-arthritis of the hip is an occasional indication. In rheumatoid arthritis the knees are manipulated more frequently than any other joint because of the frequency of flexion deformity. Serial manipulations with serial plasters are preferable to one major manipulation.

Of the joints which do not respond to manipulation, the elbow is the outstanding example. Arthritis is usually aggravated and myositis ossificans may occur.

G. D. Kersley

Disease Factors

A gouty joint is always unsuitable for manipulation; fixation following fibrositis may react well, but gradual stretching or movement without an anaesthetic often yields a better result. Certain cases of osteo-arthritis benefit, as the increased range of movement due to a ruptured adhesion allows the use of a new joint surface. In rheumatoid arthritis absence of activity of the disease is no longer a contra-indication, especially since the discovery of corticotrophin and cortisone. The use of one of these hormones as a "cover" for a manipulation is one of their most practical applications in the rheumatic diseases. At the moment an investigation, with controls, into the value of this procedure is being carried out; the results are definitely encouraging.

Methods

Manipulation may be divided into (1) those performed with or without anaesthesia, by the consultant and (2) those carried out more gradually by the physiotherapist in the hot pool. In the pool, muscular spasm is relieved, the force of gravity reduced to a minimum, and the circulation improved. This gentle manipulation is often most helpful in mild capsular and pericapsular fibrosis of the shoulder, and also as a follow-up treatment after other forms of manipulation.

Finally a word on technique. In the rheumatic diseases it is better to do too little than too much, and to repeat the manipulation as soon as the reaction has settled. After the manipulation, analgesics and heat should be used liberally; movement, especially active movement, should be started not later than 48 hours after the operation. If in the first instance this can be carried out in a hot pool it is a great advantage. After-treatment and the co-operation of both the patient and the physical medicine team are essential if a good result is to be obtained.

III—D. A. KININMONTH

This paper consists of a review of case notes of 109 patients treated by manipulation. My aim is to show that from the history and physical signs it is possible to deduce in which case manipulation is the treatment of choice, and conversely to show that in a patient with very similar symptoms but a different type of history, and with a different set of physical signs, manipulation is contraindicated. The 109 patients whose case notes were analysed included 61 with low back pain, 16 with sciatica, 14 with dorsal backache, and 18 with tennis elbow.

Discussion on Manipulation

Low Back Pain

In this, the largest, group the features of the history and physical examination were tabulated under the following headings: (1) Age; (2) Occupation; (3) History: (a) of trauma, (b) of previous trouble of a similar nature; (4) Symptomatology: (a) whether symptoms were initially bilateral or unilateral, (b) mode of onset (gradual, acute), (c) severity, (d) duration, (e) whether any spontaneous improvement had been taking place; (5) Clinical examination: (a) articular signs by examination of the spinal movements, (b) presence or absence of signs of root irritation by the straight leg raising test, and by testing the reflexes, power, and sensation in lower limbs

Results.—20 of the 29 males and 12 of the 32 females were discharged symptom-free. Manipulation was carried out three times a week for an average of three to four weeks. In the majority of cases which responded to manipulation the onset was sudden; pain was first felt in the midline and later radiated to both sides of the back. After four or five days the acute pain subsided and the patient was left with an intermittent pain on movement of the trunk. This is the stage at which the majority were first seen. There were slight differences in the clinical findings as between the male and female patients. In the males the back was symmetrical, though there was sometimes flattening of the lumbar lordosis. In a third of the cases there was a painful arc of movement, by which is meant that pain was felt in the central part of the range of movement, and disappeared when this point was passed in either direction. It was more commonly felt in trunk flexion, though occasionally it occurred with extension or side flexion. In all cases flexion was free and there was no evidence of root involvement by the straight leg raising test or on examination of the central nervous system. In the women an arc of pain on trunk movement was exceptional, pain being most frequently caused by extension. Flexion was relatively free; straight leg raising caused slight discomfort in the back in 50% of cases.

In both males and females, manipulation failed when there were pain and limitation of movement on flexion of the spine, and when the straight leg raising test was positive.

Of the 32 rendered symptom-free by manipulation, 10 had a recurrence within a year. In those who had been provided with a surgical corset there were no recurrences.

Sciatica

Manipulation was carried out in 16 cases of sciatica in which the diagnosis of prolapsed intervertebral disk had been made; it failed in every case; however, improvement was noted in 9 when traction was instituted.

D. A. Kininmonth

Dorsal Backache

Of the 14 cases of dorsal backache treated by manipulation, the response was excellent in 10; only 1 recurred. The four failures showed X-ray evidence of old osteochondritis.

Tennis Elbow

Manipulation is often advocated for the non-specific lesion of the wrist extensors known as tennis elbow; 18 patients with this condition were treated by repeated manipulation. In every case, symptoms were elicited by extension of the wrist against resistance; there was tenderness over the anterior aspect of the elbow and the lateral humeral epicondyle; movements of the elbow joint were full and painless. Of the 18 patients treated by manipulation, 9 were discharged symptom-free within three months—a cure rate obtainable by almost any other form of physiotherapy.

The VIIIth International Congress of Rheumatic Diseases will be held at Geneva and Aix-les-Bains from August 24 to 28, 1953. There will be, in addition to a full scientific programme, technical and scientific exhibitions and a demonstration of films. Particulars may be obtained from Prof. K. M. Walthard, Institut de Physiatrie, Hôpital Cantonal, Geneva, Switzerland.

INTERNATIONAL FEDERATION OF PHYSICAL MEDICINE

THE International Federation of Physical Medicine was formally constituted at a meeting of the International Representatives held on Sunday, July 13, 1952, at King's College, London. Dr. FRANK KRUSEN was elected the first President of the Federation, Dr. PHILIPPE BAUWENS Honorary Secretary, and Dr. HUGH BURT Honorary Treasurer. It was agreed that the permanent offices of the Federation should be in London until the time of the next Congress, when the matter will be reconsidered.

The physical medicine associations of the following countries were elected founder members:

Argentina	Holland
Australia	Israel
Austria	Norway
Belgium	Spain
Canada	Sweden
Denmark	Switzerland
Germany	U.S.A.
Great Britain	

It was agreed that the next International Congress should be held in Denmark in 1956.

BRITISH ASSOCIATION OF PHYSICAL MEDICINE

POSTGRADUATE COURSE OF LECTURES IN PHYSICAL MEDICINE

A POSTGRADUATE course in physical medicine will be held on Saturday mornings during October, November, December, and January. Classes will assemble at 10.15 a.m. at various London Hospitals.

In addition, if there is sufficient demand from the Provinces, a week-end course will be arranged at the end of January or the beginning of February.

The fee for the Saturday morning course will be three guineas, and that for the week-end course two guineas.

Those interested in either course should apply to the Honorary Secretary, British Association of Physical Medicine, 45 Lincoln's Inn Fields, London, W.C.2, as soon as possible.

In order that provincial candidates for the Diploma in Physical Medicine can become familiar with other departments, the Directors of the Physical Medicine Departments of the London Teaching Hospitals invite those candidates who wish to visit their Departments to do so during the week immediately preceding the examination.

ABSTRACTS OF WORLD LITERATURE

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Identification of Certain Reflexes in the Electromyogram and the Conduction Velocity of Peripheral Nerve Fibers. J. W. MAGLADERY and D. B. McDOUGAL, Jr. *Bull. Johns Hopk. Hosp.*, May, 1950, lxxxvi, 265.

The authors evoke muscle action potentials in the hypothenar, calf, and foot muscles by stimulation of their respective nerves with cathodal shocks of 0.5 millisecond's duration. Each stimulus produces three successive responses.

The first action potential following the stimulus artefact is caused by direct propagation of the impulse along efferent fibres. The more distal (closer to the muscle) the point of stimulation, the shorter is the latency between stimulus and response. This first deflection always increases to a maximal value with increasing intensity of the stimulus.

A second potential change is seen several milliseconds after the first one. It is considered to be due to a reflex contraction caused by stimulation of afferent fibres. This interpretation is borne out by two facts: (1) procaine block of the nerve proximal to the stimulus abolishes this wave; (2) the more proximal (closer to the spinal cord) the point of stimulation is, the shorter is the latency between stimulus and this second response. In the hypothenar, peroneal, and foot muscles this potential increases with increasing intensity. In the calf muscles, however, it reaches a maximum with moderate stimuli to the posterior tibial nerve, then declines and disappears with further increase. In this case the conduction velocity of the afferent fibres is so great that the reflex response occurs while the motor fibres are still in the refractory phase from the first impulse. If the stimulus is so strong that all motor fibres participate in the first wave, none will be available for the reflex response. The slower conducting fibres in the ulnar and peroneal nerves produce a reflex response after the refractory phase of the motor fibres is over.

A third potential of late waves was observed. These potentials have the characteristics of voluntary contraction.

Conduction velocity of motor nerves (efferent) was determined by stimulating the nerve at two points a certain distance from each other. The difference in latencies of the two action potentials is the time necessary for the impulse to cover the distance between the two points of stimulation. For the ulnar nerve in the forearm the average conduction velocity was 55 m. per second, for the posterior tibial nerve in the leg, 45 m. per second. Conduction velocity in the proximal segment of the limb is greater than in the distal portion.

Conduction velocity of sensory (afferent) fibres was found by recording nerve action potentials with skin electrodes applied proximally to the point of stimulation. Here the latency between stimulus artefact and nerve action potential indicates directly the time of travel of the impulse from the point of stimulation to the recording electrode. Conduction velocities of afferent

Abstracts

fibres are 60 to 70 m. per second. They are also greater in the proximal than in the distal portion of the limb. Decrease in fibre size is held responsible for the distal slowing of the nerve impulse.

A Method of Measuring Reflex Times applied in Sciatica and Other Conditions due to Nerve-root Compression. D. S. MALCOLM. *J. Neurol. Neurosurg. Psychiat.*, January, 1951, xiv, 15.

This is a beautiful piece of research in which the author measured reflex times and conduction rates in normals and patients with herniated intervertebral disks by an electromyographic method. A tendon hammer blow (which simultaneously started the sweep of the recording oscilloscope) or else an electric shock applied directly to the nerve-root at operation were used as stimuli. Both surface and needle electrodes were used and the author mapped the character and height of response from many different areas of several muscles tested. Reflex times were then measured on patients at operation and pre-operatively by the same technique. The author demonstrated that a delay in conduction time occurs with root compression and that this is not always reflected in diminution of the ankle or knee jerk. In the normal subjects he found that the strength of a stimulus was not an important factor in conduction time, nor was reinforcement, tension of the tendon, or the placement of surface versus deep electrodes. Fairly good agreement was found between the height of the patient and the reflex time. The author noted that the existence of central nervous disorders such as pyramidal, extrapyramidal, and cerebellar diseases did not materially affect reflex conduction time.

The author concludes that his study shows how constant the reflex time is in health and disease, being unaffected in metabolic disturbances as well as in the other conditions mentioned. The fact that a delay frequently occurs in sciatica is therefore held to be of definite significance. Experimental results show that it is in the unilateral lesions of the first sacral nerve-root that a delay in the ankle-jerk reflex time is most constantly found.

The reviewer feels that this is an entirely dependable and beautifully carried out piece of research. The technique described will be of great use to investigators doing experimental electromyography.

Über eine Heilgymnastische Behandlungsmethode des Kindlichen Asthma bronchiale. GERTRUD RANKE. *Münch. med. Wschr.*, November 10th, 1950, xcii, 1310.

Of 22 children with bronchial asthma treated by breathing exercises, 18 were cured or greatly relieved. Neither the procedures used nor the rationale offered by the author are clear to the reviewer. The aim of the treatment is to relieve the anxiety of the child by proving to him that he can help himself; that he can ease or even stop his attacks by assuming certain positions and by using a specific breathing pattern. Breathing exercises should start early. They should be shown to the child several times in the presence of the mother, who will supervise them at home. Instead of calling them breathing exercises in front of the child they are referred to as game activities: singing, humming, blowing out candles. The development of a happy relationship between the child and the therapist seems of utmost importance to the author.

Abstracts

Some Views on the Treatment of Knee-joint Exudate. RAGNAR MAGNUSSON. *Acta orthopaed. scand.*, 1951, xx, 130.

A discussion of the treatment of knee-joint exudate is difficult because so little is known about the causes of knee-joint effusion. The choice of treatment depends mainly on the length of time the exudate has been present. Conservative therapy is concerned with the exudate itself and the degree of quadriceps atrophy. Heat, rest in bed, and even immobilization are measures which influence the amount of exudation, but of equal importance is the treatment of quadriceps insufficiency, for even when this is slight an unstable joint may result. Functional disharmony can lead to the formation of more exudate and the establishment of a vicious circle. The author recommends early energetic exercise of the quadriceps: "The sooner this is done the better." He also believes that exercise facilitates the resorption of exudate which has collected in pockets and bursae formed by the capsule as a result of the pumping action of the moving knee.

Water as a Medium for Therapeutic Exercise. ROBERT L. BENNETT. N.Y. *St. J. Med.*, February 15th, 1951, li, 513.

The smallest practical therapeutic pool should measure 7 by 8 feet. It should be equipped with an underwater table, chair, and parallel bars. The depth should vary from $2\frac{1}{2}$ to 5 feet to enable patient support with varying levels of water. If the pool is higher than floor level, the patient can be carried into it by an overhead or other hoist. The temperature of the water should be maintained at 88° to 90° F. The pool may be used for relaxation, mobilization, and strengthening of body segments limited in range by neuromuscular or musculo-skeletal disease. Underwater therapy is useful in the following conditions (in order of frequency employed): degenerative arthritis, hemiplegia, rheumatoid arthritis, postural low back pain, post-operative care, polyneuritis, cerebral palsy, multiple sclerosis.

The Analysis of Muscle Action Potentials in the Differential Diagnosis of Neuromuscular Diseases. A. T. RICHARDSON. *Arch. phys. Med.*, April, 1951, xxxii, 199.

Dr. Richardson, on his recent visit to this country, not only presented this excellent paper at the Annual Congress meeting, but personally visited many centres of physical medicine in his swing around the country and talked with many of us who are doing electromyography. We are all extremely envious of the magnificent equipment which Dr. Bauwens and he have at their disposal at St. Thomas's Hospital in London. The ability to select a run of transients and record them on tape for leisurely re-examination is something we really envy. We are not in a position actually to compare the English results with our own because of the difficulty we have in record analysis. We have not felt as confident in the Washington University Laboratories of our ability to identify polyphasic and nascent action potentials as other investigators are. The illustrations shown by Dr. Richardson, however, are certainly convincing.

The author divides his paper first into a discussion of technique and a description of normal action potentials. He then considers fibrillation

Book Reviews

potentials and shows some nice examples of these. Reinnervation potentials are next shown and irritative phenomena including the "diving-airplane" syndrome seen in dystrophia myotonia.

The reviewer is envious of the fine work which is going on elsewhere and confesses to some inadequacy both of technique and of interpretation. We do not in this laboratory feel that electromyography has reached the point of being a clinical discipline like electrocardiography. None of the apparatus so far demonstrated by any investigator completely answers the basic needs from the point of view of expense, number of channels, reliability, simplicity, etc. Until some basic standardization of this kind has been carried out there will always be differences—merely of technical reproduction—let alone of interpretation.

BOOK REVIEWS

The Treatment of Gravitational Ulcers by Physiotherapy. By AUDREY E. BARTHOLOMEW, M.C.S.P. London: Green Bank Press. 10s. 6d.

This monograph, which is written primarily for the physiotherapist, contains a detailed account of the modified Bisgaard method of treatment for gravitational ulcers, with all the information required for its application. The rationale of the treatment is outlined in the introduction.

A full description of the technique is given, with photographs and line drawings to demonstrate each step. Case histories and results are recorded to illustrate the clinical variation of the types of lesions encountered and their response to treatment. Ancillary methods, such as the application of ultra-violet radiation, are fully discussed and placed in proper perspective with relation to the basic regimen. Examples of simple, bland applications for dressing ulcers are given, with reference to the relative unimportance of the use of antibiotics.

The training of patients in the care of their own limbs is stressed, as results depend upon adequate after-care. Careful thought and sound clinical observation have been brought to bear on the management of the individual patient as well as his local condition.

Miss Bartholomew has obviously had considerable experience in this field, and must be congratulated on producing a comprehensive guide to a logical method of treatment which should prove of great value to the members of her profession; medical men who are interested in the subject will also find it interesting and informative.

I. H. M. CURWEN

Modern Ideas on Physical Education. By M. W. RANDALL, Senior Lecturer, Physical Education, City of Worcester. London: G. Bell & Sons. 1952. Pp. 128. 7s. 6d.

In his foreword to this book Mr. Munrow suggests that it will serve as a useful guide to students who wish to read selectively from American sources. He also says that the book is not only a guide to transatlantic reading material, but also a useful contribution in itself. This is very true, as the author has the

Book Reviews

courage to deal with controversial matters in the world of physical education and state his point of view. Too frequently such issues as what to call the physical training lesson, the reasonable scope of physical education in the average school, the problem of teacher domination, work in unison and free practice, etc., are avoided. All readers may not agree with his conclusions, but the author states his point of view with honesty and possibly reaches the heart of all these and many other problems when he says that "each individual has to make his own personal compromise; . . . he is not required to act a part, to behave like somebody else . . .".

Certain of the theories advanced will doubtless give rise to some discussion, and it is good that this should be the case. For instance, is there any conclusive evidence that in the past there was less satisfaction of the real needs of the children and more giving of what was felt to be good for them? Do we really know that the approach of to-day is more satisfying to the child, or are those who preach extremes of modern practice equally guilty of giving what they think the child ought to want? Will all agree that the teacher should always be in the background and as unobtrusive as possible?

Perhaps the solution to all these problems may lie in the welding of the best of the old (and let it not be forgotten that there was much that was good) with the best of the new.

This is an excellent publication which will provide physical educationists with food for thought and discussion, and much of it will be of interest to those doctors who are concerned with physical medicine.

A. H. GEM

The Science and Art of Joint Manipulation. Vol. II—The Spinal Column.
By JAMES MENNELL. London: J. and A. Churchill. 1952. Pp. 264.
42s.

Mennell's splendidly produced volume on manipulation of the spine is not only a sequel to Vol. I on the extremities (now in its second edition), but also embraces an earlier monograph on backache. It is, therefore, a more comprehensive study than its title would suggest.

Criticism may be levelled on the score that so few pages are devoted to the prolapsed intervertebral disk, and so many to derangements of the lumbosacral and sacro-iliac joints, though the author argues convincingly on the role of these joint disorders in low back pain. The reviewer would have liked a longer chapter on the clinical history and the clues to diagnosis that the history may afford.

Outstanding features are: (1) the exhaustive account of the examination of the back and the differential diagnosis consequent on this examination; and (2) the description, supplemented by admirable line drawings, of the manipulative techniques which can be employed. The remarks on the importance of the fascial planes, in particular the ilio-tibial bands, recall Ober's interesting but now unfashionable hypothesis.

To those who believe that the prolapsed disk is *not* the only cause of back pain—and there are signs that the pendulum is swinging from the disk to other derangements of the back—this book will be of interest and value.

HUGH BURT